

operation he had been having them with every epileptic attack. His one recurrence took place in from three to four weeks after operation, and then from a degree of violence sufficient to have produced a dislocation in a normal shoulder. The condition is essentially a hernia of the joint, and the operation of capsulorrhaphy for the contraction of the capsule has given relatively as good, if not better, results than the Bassini operation for inguinal hernia.

Although, in all the 34 cases collected from the literature, the incision employed either divided the deltoid muscle or separated it from the pectoralis major, I believe that the axillary incision is

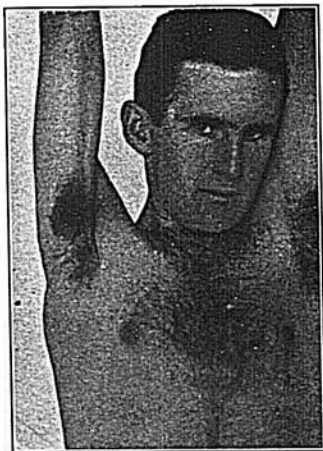


FIG. 6.—Arms in full abduction. The space between the head and the right arm is due to inclination of the head to the left side. Since this photograph was taken the scar has lost its rigidity.

better. By this route the deltoid is avoided, the site of the original anterior capsular tear and the resulting protrusion of the capsule are better exposed; the incision required is smaller, and if drainage should be necessary it would be dependent.

Judging from the results obtained by the various methods employed in the reported cases it would seem that an exact method of shortening the capsule is not important: although a folding of it by sutures without an opening in it, and therefore without intra-articular exploration, should be avoided, since a movable joint body, free or attached, may then be overlooked. The shortening may be provided by excision of a piece of the capsule and

uniting the margins of the opening by sutures, or by overlapping the borders of an incision made in the capsule. If the margins of the original tear are found, as in my case, they may be united by sutures.

I hope that this study of the subject will increase the confidence of the profession in shortening the capsule, as an operation quite sufficient for a radical cure, and that thereby many more sufferers from recurrent dislocations of the shoulder will find relief.

A RÖNTGENOGRAPHIC STUDY OF PERISTALSIS: THE RELATION OF WAVE FORM TO FUNCTIONAL ACTIVITY.

By CHARLES LESTER LEONARD, A.M., M.D.,
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RECENT studies upon the living subject show that the normal stomach varies widely in shape and anatomical relations in different individuals. These normal variations differ entirely from the classical description of the anatomists. In fact, the physiological variations are so great that no type has been agreed upon as normal. The conclusion to be drawn is that the shape varies with the characteristics of the individual and that the stomach is normal which fulfils its functions perfectly.

The stomach is a freely movable, distensible organ, suspended at its cardiac and pyloric extremities. It varies in its size and shape with the amount of food ingested and the support given it by the other viscera under an intra-abdominal pressure exerted by the abdominal parieties. Its lower border and walls are freely distensible, while its lesser curvature is more rigid. It, however, changes its length and position in a remarkable manner even under normal conditions. It extends in length with an increased load, so that the pyloric end is often pushed far over to the right and curves back upon itself to the pylorus.

Deficient functional power may be present in stomachs that conform in shape to those having perfect function. Gastrectases, gastropnoes, and pyloroptoses have been described as pathological conditions. The significance of form can only be determined by estimating the functional efficiency in the individual case. This functional efficiency can only be determined by the ability of the stomach to empty itself in a given time.

Exclusive of newgrowths, ulcerations, scar-tissue contractions, and ptoses, gastrectases are the pathological conditions that most frequently interfere with functional efficiency. They may arise

from two diametrically opposed states. They are, on the one hand, the passive dilatation due to muscular atony and due to over-distention and lack of intra-abdominal support, and, on the other hand, dilatation with hypertrophy of the muscles caused by organic or spasmodic stricture of the pylorus. They are, therefore, sthenic and asthenic forms of gastrectasis, in which functional efficiency is defective, as shown by the residue of an ingested meal after the normal period in which the stomach should have emptied itself. The presence of this abnormal residue is determinable by employing the bismuth meal and the Röntgenographic method of examination. This, however, determines only a lack of motor efficiency, and does not differentiate between the sthenic and asthenic forms.

Is it possible for the Röntgen method to differentiate in any way between these two forms of motor insufficiency? The study of the stomach by the Röntgen method of examination has shown, in addition to the determination of motor insufficiency, variations in the size, shape, and position of the stomach. It has, in addition, determined the presence of newgrowths and scar-tissue contractions invading its lumen. The results of these studies upon the normal position and shape of the stomach and their pathological variations have been discussed at length by various authors, and will not be considered in this paper. This study is confined to variations in the form of peristaltic waves in their relation to normal and pathological conditions and their relation as a possible means of differentiating between the sthenic and asthenic types of gastrectasis.

Recent advances in apparatus and technique have made it possible to make instantaneous Röntgenograms of the stomach and intestines, which show some of the various forms of peristaltic waves under different normal and pathological conditions of the stomach. Although they are not as yet so extensive or complete as to justify absolute conclusions, certain deductions can be drawn with reference to the relation of peristaltic wave form to functional efficiency, which will aid in differentiating the sthenic from the asthenic pathological conditions of the stomach.

These studies show that there is a constant relation between the form and amplitude of the peristaltic wave and the amount of work to be accomplished, that the amplitude of the wave varies with the character of the food ingested, the position of the patient, and the amount of the gastric contents. They have shown that the amplitude varies in pathological conditions. The variations in sthenic and asthenic forms of gastrectasis are so distinct that apparently a differentiation can be made between gastrectasis due to a weakened musculature and that due to pyloric stenosis, whether organic or spasmodic. In the asthenic type the waves of peristalsis are practically absent when the patient is in an erect position and of but slight amplitude when the patient is prone or recumbent. In the sthenic

type the wave is of greater volume and less frequent, but particularly strong, when the patient is prone. The therapeutic value of rest after eating for all cases of motor insufficiency is thus demonstrated, since the waves are increased in strength.

The study of the peristaltic waves in the normal stomach under varying conditions in the kind and amount of food ingested shows that in the human subject the conditions are practically identical with those determined by Cannon in his classical studies on animals with the bismuth meal and fluoroscope. The difference between solids and liquids is seen not only in the stomach, but also in the œsophagus, boli of bismuth in bread and milk passing separately along the œsophagus, while bismuth in kumiss shows the entire shadow. The peristaltic waves vary in volume with the amount of food ingested, but are alike in type for the same kind of food, the shape of the waves differing when fluids or semisolids are employed.

When bismuth is taken in a glass of water the water is rapidly absorbed and the stomach is shown in its resting or nearly empty state, with a fine saw-tooth form of peristaltic wave. As the load increases, the amplitude of the wave increases, while its sinuous type persists. With semisolid contents, as bread and milk or rice pudding, the waves become less frequent with a greater amplitude, which shows that more work has to be done.

These characteristics are most prominent when the patient is prone, but retain their individuality of type when the erect position is assumed. In gastrectasis of the asthenic type all waves are practically absent when the patient is in the erect position. In the prone position they present the normal type, but are less frequent, while their decrease in amplitude shows the motor insufficiency. In gastrectasis due to obstruction the volume of the wave is more pronounced, though they are less frequent and are still more marked with the patient in the prone position, their increased amplitude showing that more work has to be accomplished.

The variations in the character of food ingested have not as yet been sufficiently great to determine the relative rapidity of their discharge from the stomach and passage through the intestines. They indicate, however, the possibility of further studies of great physiological interest.

One physiological fact, which had been suggested previously as possible, they have established, that is, that the stomach elongates to a marked extent during expiration. In one instance the difference in the perpendicular length of the stomach was one and one-half inches greater during expiration than in inspiration, while the base of the stomach remained at the same level. This motion may, in a measure, account for the ejaculatory expulsion of food from the pylorus which has been observed by some operators as distinct from the flow resulting from peristaltic action. Marked changes have

also been noted in the relation of the pyloric portion of the stomach to the pylorus itself, the stomach passing to the right beyond the pylorus and curving back upon itself.

The study of intestinal peristalsis has demonstrated differences in their character and in the shapes of their contents, but no segmentation, as described by Cannon in his observations on animals, has been shown. The peristaltic motion of the small intestine is so rapid that one-half second exposures are necessary to define sharply the fecal masses in the duodenum. Their shape differs entirely from that seen in the large intestine, indicating the presence of secondary waves of less volume. They apparently decrease in rapidity as the cecum is approached.

In the large intestine the subdivision of the intestinal contents is remarkable because of its completeness. This almost complete segmentation of the fecal masses, extending throughout the entire colon, indicates that the process of absorption continues throughout the entire colon. Various degrees of enteroptosis have been observed. That of the hepatic flexure is most common, and often includes the entire ascending colon, while ptoses of the splenic flexure and descending colon are rare. These ptoses seem to have little effect upon the motor efficiency of intestinal peristalsis, since the passage of the bismuth meal is apparently not delayed in cases in which they are present. They have, however, been found in cases suffering from intestinal indigestion, though their relation to this condition cannot be inferred, since they are found in other patients.

The plates to be shown illustrating these studies were made with an exposure of from one-half to one second. The meal employed was two ounces of bismuth, either subnitrate or carbonate, in water, kumiss, bread and milk, or rice pudding. Observations were made during the act of swallowing immediately after the ingestion of a part or the whole of the meal, and at intervals, one hour, six hours, and twenty-four hours after eating.

The accompanying plates illustrate the varying phases of peristaltic motion in some of the cases upon which this paper is based. Many of the patients presented marked gastric and intestinal symptoms, but those in which no motor insufficiency was present have been considered as normal in the type of peristalsis, since they did not differ from the normal cases studied.

The first illustrations show the difference between the passage of fluids and semisolids through the œsophagus.

Fig. 1 shows the entire œsophagus coated by two swallows of bismuth in kumiss. It was taken with the patient in the right oblique position, and shows the relation of the œsophagus in the mediastinum to the heart and spinal column.

Fig. 2 shows two boli of bread and milk with bismuth, passing down the œsophagus. The lower bolus is arrested at the dia-



FIG. 1



FIG. 2

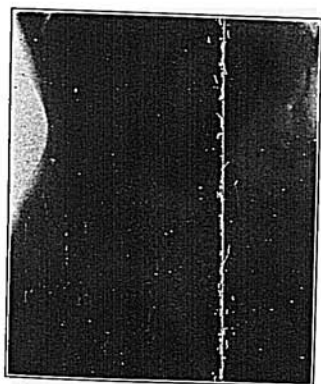
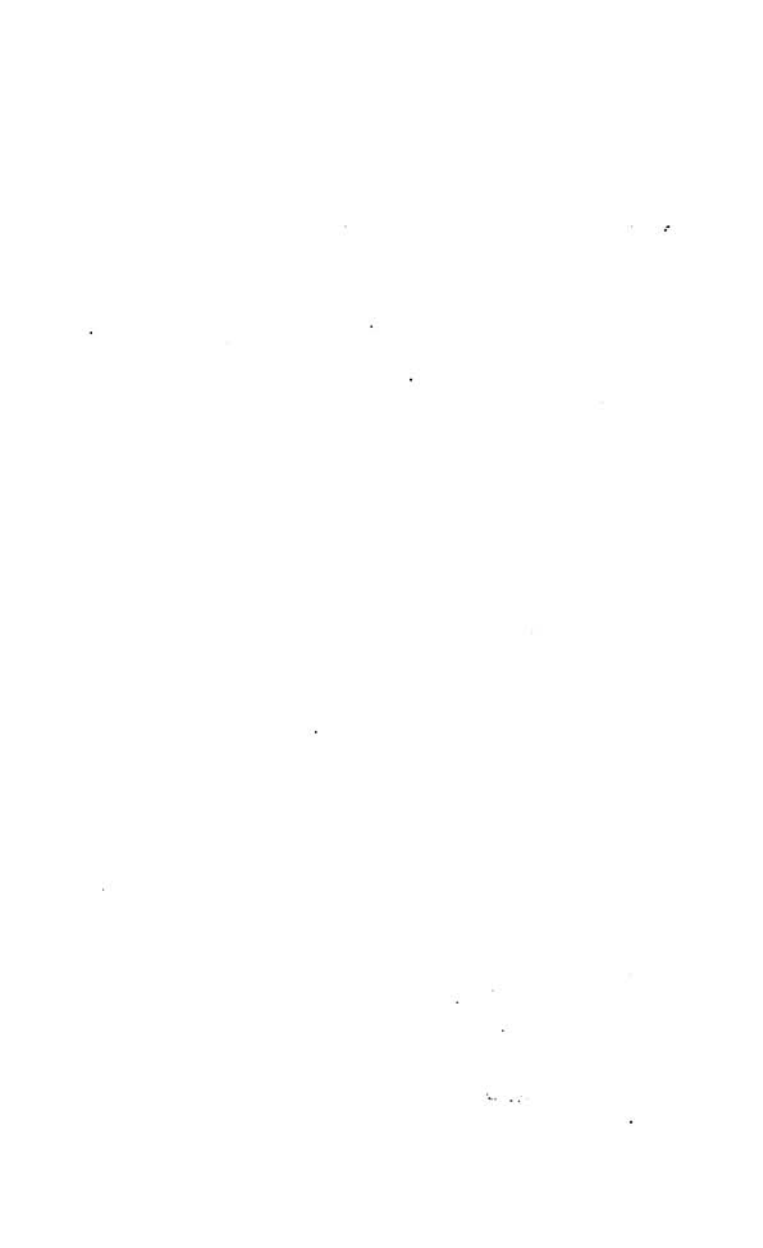


FIG. 3



FIG. 4



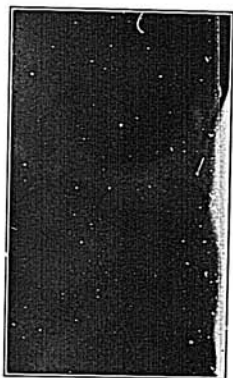


FIG. 5



FIG. 6



FIG. 7

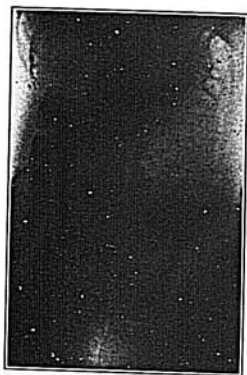
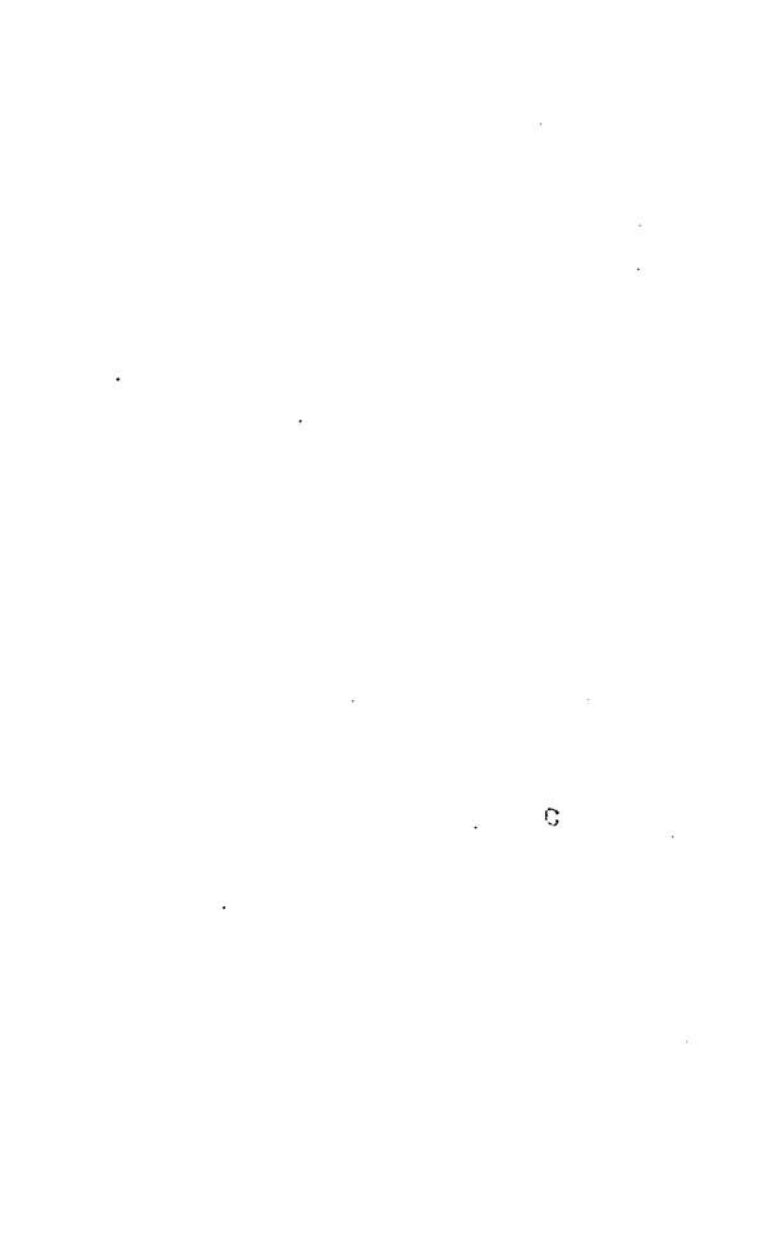


FIG. 8



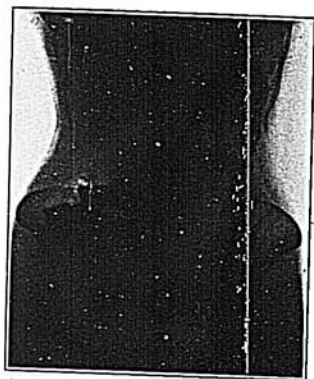


FIG. 9

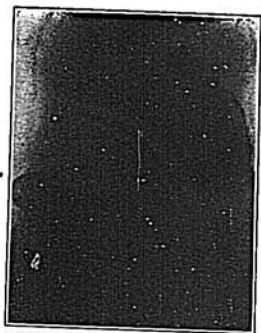


FIG. 10

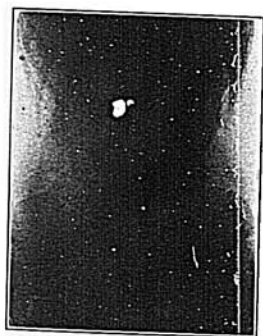


FIG. 11



FIG. 12

phragmatic opening, in which a small portion is seen as a dark line projecting downward through the diaphragm.

Fig. 3 shows a normal stomach in a state of rest, the bismuth having been given in a glass of water. The stomach in this instance has the form of a distended intestine, with a very fine saw-tooth type of peristaltic wave, indicating that very little motor activity is demanded.

Fig. 4. The stomach is here partially filled with four ounces of a bismuth and kumiss meal. There is a distinct "Magenblase" filling the cardia. An undulatory peristaltic wave of small volume shows on the greater curvature of the stomach.

Fig. 5. This is the stomach of a man aged fifty years, with two ounces of bismuth subnitrate in a half pint of kumiss. The undulatory character of the peristaltic wave with fluid ingesta is striking. The fluid media with the bismuth can be seen rapidly passing through the pylorus, the ascending, the descending, and the re-ascending limbs of the duodenum. The exposure in this case was one second, and was not short enough to show the peristaltic waves of the duodenum.

Fig. 6. The bismuth meal consisted of bread and milk, and the stomach is partially filled with the patient in the erect position. The level of the fluid in the stomach is clearly defined, with the "Magenblase" or gas-filled cardia above, while below the level of the fluid is a second line which corresponds to the upper limit of the denser portion of the meal. Single undulatory waves of peristalsis of slight volume are seen along the greater curvature.

Fig. 7. In this patient the bismuth was given in eight ounces of rice pudding. The peristaltic waves are seen to differ from those of the fluid meal, and are typical of the more solid gastric contents. The wave is seen to be deeper and single, showing on both the lesser and the greater curvature. The longitudinal rugæ are distinctly seen filled with the bismuth meal where the stomach has widened in its upper portion after the passage of the peristaltic wave.

Fig. 8 shows the gastric residue and intestinal contents six hours after the bismuth meal in a case of defective motility of the asthenic type. The weak peristaltic wave is seen in the stomach, though the patient was in the prone position. The entire small intestine is shown filled with the bismuth meal.

Fig. 9 shows the large intestine of the same case as Fig. 7 six hours after the ingestion of the rice pudding and bismuth. The distinct segmentation of the feces is noted throughout the entire colon. There is a complete ptosis of the ascending colon and hepatic flexure, carrying with it the transverse colon. The splenic flexure is seen in its normal place with gaseous contents, while an accumulation of gas is also seen in the cecum. This plate was taken with the patient in an erect position. In another plate taken in the

prone position about the same time there is no alteration in the position of the intestine, but the gas is absent from the cecum.

Figs. 10, 11, and 12 are from the same patient, and are of particular interest, because they show motor insufficiency due to pyloric stenosis, the result of ulceration and spasm of the pylorus, which was demonstrated by a subsequent operation. In Fig. 10 there is a marked peristaltic wave in the lower third of the stomach nearing the pylorus. It involves both the lesser and greater curvatures, and corresponds to what has been described as the "sphincter antrum pylori." A second commencing wave is seen between the middle and upper thirds of the stomach, while the perpendicular rugæ of the cardia and left side of the stomach are shown by the bismuth remaining in them as the stomach expands laterally. It should be particularly noted that the lungs are filled with air, shortening the saggital length of the stomach, while its base is at the iliac crest or a little below it. When this plate is compared with Fig. 11 of the same stomach, taken immediately after the other, but with full expiration instead of full inspiration, the contrast in the length of the stomach is easily noted. The base remains at the same level, only it is narrower, while the peristaltic wave, called the "sphincter antrum pylori," has disappeared, and a second wave is shown in the middle third of the stomach. In addition, a very small notch, on the outer border of the stomach between the upper and middle thirds, indicates the commencement of another peristaltic wave.

Fig 12 shows the stomach and intestines of the same patient six hours after the bismuth meal. The residue of the bismuth meal is shown in the lower part of the stomach with marked peristaltic waves. Bismuth is seen in the pylorus and the descending and ascending links of the duodenum. The greater portion of the meal has, however, passed into the cecum and the ptosed ascending colon, but the transverse and descending portions of the colon are empty. This is in marked contrast to the condition of the colon in Fig. 9, where the meal has passed into the descending colon in the same length of time. In this plate the gas-filled portion of the colon can be seen, and also very distinctly the spleen and lower border of the liver. The presence of this residue in the stomach shows motor insufficiency, but the character and strength of the peristaltic wave indicates no lack of muscular power, so that some form of obstruction was diagnosed. The subsequent operation disclosed an ulcer near the pylorus with a spasmodic stricture.

INTESTINAL SAND: THE BANANA ONE OF ITS SOURCES.

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A CAREFUL perusal of the literature on intestinal sand brings one to a realization of the chaotic state of the entire subject at the present time: the symptomatology, the nomenclature, and the descriptions of intestinal sand are at present at great variance. Our attention was first directed especially to the subject by a case which we believed to be one of "true intestinal sand." Upon further study, however, we ascertained the real but extraneous origin of the sand, and at the same time we were led to the conclusion that the substance described in many of the cases owes its origin to the same or a similar source as that of our own. Contrary to the teaching of the French school especially, we do not consider intestinal sand a clinical entity nor productive of a definite train of symptoms. In arriving at these conclusions, we have endeavored to present as complete a bibliography as possible, and although some of the articles quoted may seem irrelevant, they have become so intimately interwoven with the literature in general that we deem it wise to record them here.

The sand in our case was of definite character, a finely divided material, and was passed by a young woman, aged twenty-four years, complaining of a feeling of intense fulness in the abdomen and chronic constipation. There was no gout or rheumatism in the family. The abdomen was tense and slightly tympanitic; there was a movable right kidney of the second degree; the stomach was in moderate ptosis, but otherwise negative. The feces were dark brown in color, firm in consistency, and contained a little mucus and fine granules resembling sand. One to one and one-half grams of this sand was washed from the feces daily. This sand was found in the motions for two weeks and then gradually disappeared. A nearer description of the substance will be given later.

We were at a loss to explain the phenomenon or to know in what relation the presence of the sand stood to the symptoms of which the patient complained. Nor did reference to the various textbooks at hand tend much to enlighten us.

Emerson writes:¹ "True intestinal sand, of which we have seen but one good case, seems to be the result of a secretory neurosis of the intestine. It occurs in neurasthenic persons, and often in association with membranous colitis. Such stools are often pre-

¹ *Clinical Diagnosis*, 1906, p. 371.